LLNL Environmental Restoration Division Standard Operating Procedure	TITLE: Installation of Dedicated Sampling Pumps
APPROVAL Date _____ _____ Environmental Chemistry and Biology Group Leader	PREPARERS: R. O. Devany**, R. Goodrich, and J. Greci REVIEWERS: R. Brown*, T. Carlsen, E. Christofferson*, V. Dibley, J. Duarte, B. Failor*, B. Hoppes*, G. Howard, B. Johnson, P. J. Lyra, D. Ramsey*, and B. Ward*
APPROVAL Date _____ _____ Division Leader CONCURRENCE Date _____ _____ QA Implementation Coordinator	PROCEDURE NUMBER: ERD SOP-2.8 REVISION: 2 EFFECTIVE DATE: December 1, 1995 Page 1 of 14

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1.0 PURPOSE

To describe selection criteria and installation techniques for dedicated sampling pumps in ground water monitor wells to ensure installation is completed in a sound, consistent, and reliable manner.

2.0 APPLICABILITY

This procedure is applicable for use in the selection and installation of well purging and/or sampling devices. All personnel performing such tasks should review this procedure prior to commencement of related activities.

3.0 REFERENCES

3.1 Barcelona, M. J., J. A. Helfrich, E. E. Garske, and J. P. Gibb (1984), "A Laboratory Evaluation of Ground Water Sampling Mechanisms," *Ground Water Monitoring Review*, Spring, pp. 32-41.

3.2 Nielsen, D. M. and G. L. Yeates (1985), "A Comparison of Sampling Mechanisms Available for Small Diameter Ground Water Monitoring Wells," *Ground Water Monitoring Review*, Spring, pp. 83-99.

3.3 U.S. EPA (1992), *RCRA Ground-Water Monitoring: Draft Technical Guidance*, Washington, D.C. (EPA/530-R-93-001).

4.0 DEFINITIONS

4.1 Bladder Pumps

4.1.1 A bladder pump, such as a Well Wizard consists of a Teflon membrane bladder contained within a plastic or stainless steel housing. Well water fills the Well Wizard bladder through a one-way check valve at the bottom. Compressed air is forced between the pump housing and the bladder causing the bladder to compress, thus forcing water up the discharge tube and to the surface. These pumps are ideal for wells producing a sustainable yield of <1.0 gpm, where the casing depth does not exceed 150 feet, and where there is not a significant quantity of water to remove (>100 gals).

4.1.2 The nongas contact, positive displacement bladder pump has been found to cause the least amount of alteration to the sample when compared to a variety of retrieval methods (Nielsen and Yeates, 1985; Barcelona et al., 1984). Although no system can provide a true *in situ* sample, this method, if employed correctly, can yield a sample that is representative and valid for numerous field measurements and chemical analyses, including organics. However, due to relatively slow discharge rates (<0.5 gpm) the use of bladder pumps is not always practical.

4.2 Electric Submersible Pumps

4.2.1 An electrical submersible pump, such as Grundfos is a motor driven device that forces water to the surface through centrifugal force. This action is accomplished by impellers housed in a stainless steel cylindrical casing that propels water up through the discharge tube and to the surface. Some electric submersible pumps, such as the Redi-Flo 2 is equipped with a rheostat mechanism allowing a much wider range of discharge rates to be achieved.

4.2.2 Submersible pumps are generally constructed of plastic, rubber, and metal parts that can affect the analyses of samples for certain trace organics and inorganics. As a consequence, care must be taken in choosing an appropriate submersible pump for wells that may contain trace concentrations of these constituents. Grundfos electrical pumps, which are constructed from stainless steel and NBR Nitril rubber, are acceptable in investigations involving trace constituents. However, the use of Grundfos pumps is limited to wells with an internal diameter >4 in. Electrical-powered submersible pumps can run off a 115-, 230-, or 460-volt AC power supply. The Redi-Flo 2 pump can be used in 2 in. diameter wells. Pumps with 115-volt vacuum motors are single phase, 230-volt vacuum motors may be either single or three phase, and 460-volt motors are three phase pumps.

5.0 RESPONSIBILITIES

5.1 Division Leader

The Division Leader's responsibility is to ensure that all activities performed by ERD at the Livermore Site and Site 300 are performed safely and comply with all pertinent regulations and procedures, and provide the necessary equipment and resources to accomplish the tasks described in this procedure.

5.1 Field Coordinator (FC)

The FC in consultation with the Drilling Geologist (DG), Study Area Leader (SAL), Facility Task Leader (FTL), and the Sampling Coordinator (SC) selects the appropriate monitor well pump. The FC is solely responsible for ordering and ensuring proper installation of the pump once it has been selected.

6.0 PROCEDURE

6.1 Choosing the Appropriate Pump

6.1.1 In order to ensure timely, quarterly sampling of the large number of LLNL wells, and to prevent cross-contamination caused by moving pumps from well to well, all wells that produce a sufficient amount of water are fitted with dedicated sampling pumps.

6.1.2 The choice of pump type largely depends on sampling methodology, the type of constituents being sampled for, and specifications such as well depth and yield. Low yielding, wells producing <1.0 gpm are generally equipped with bladder pumps, whereas deeper wells (especially deep, high-yielding wells) producing >1.0 gpm generally require an electric submersible pump to reduce purge times. Pumps are generally installed at the bottom of the screened interval in monitoring wells at Site 300 due to the large number of low-yielding wells. Pumps at the Livermore Site are installed 1 ft. below the top or mid-screened interval, at the discretion of the FTL and/or the FC. As appropriate, the SAL or FTL determines the type and placement of all dedicated pumps.

6.2 Office Preparation

6.2.1 Identify wells requiring installation of dedicated pumps.

6.2.2 Review any available chemical analyses. The Site Safety Officer should be consulted as to the appropriate safety precautions and/or protective gear required.

6.2.3 The FC in consultation with the SC, SAL, and/or FTL, should review the available chemical analyses, drilling logs, well development, and hydraulic testing records to determine the appropriate pump type and placement for each monitor well.

6.2.4 Prior to final decision, transmit pump type and placement information to the FC for review with the field team.

6.2.5 Order any necessary equipment (i.e., such as pumps, discharge tubing, control boxes, sounding tubes, sanitary seals, etc.).

6.3 Field Preparation

6.3.1 Procure the appropriate pieces of equipment according to Attachment A, Equipment Checklist.

6.3.2 Ensure that the pump installation truck that contains a winch and an operational power supply is available.

6.3.3 Ensure that all equipment and materials to be installed in the well have been adequately decontaminated as described in SOP 4.5, "General Equipment Decontamination."

6.3.4 Locate monitor wells that require dedicated pumps. Locate staging area or areas to manage the equipment.

6.4 Operation

6.4.1 Bladder Pumps

A. Measure the appropriate lengths of discharge line, gas line, sounding tube (when necessary), and safety cable so the pump intake will be at the specified depth. Ensure that the safety cable is slightly shorter than the gas line and discharge line so it will support the pump when installed. The pump end of the sounding tube should be open to the well water and be just above the top of the pump.

B. Bundle the discharge line, gas line, sounding tube, and safety cable using plastic clamps (i.e., tie-wraps) at 5-ft intervals to ensure that the tubing does not collapse due to excessive compression.

C. Fasten the tubing to the pump and the top cap using threaded compression fittings, as specified by the pump manufacturer.

D. Attach the safety cable to the pump and top cap.

E. Feed the top of the sounding tube through the appropriate port in the top cap (when necessary).

F. Lower the complete assembly down the well by hand.

G. Install wellhead seal of appropriate size for below-grade wellheads.

H. Secure the cap assembly on top of the well casing. Place a cap on the sounding port (when necessary). Attachment B is a diagram of a well with a dedicated bladder pump.

6.4.2 Electric Submersible Pumps

A. Center the pump hoist over the well.

B. Splice the pump wiring harness to the electrical cable using watertight solderless connectors.

C. Secure safety cable to pump.

D. Thread a hoisting plug into the discharge line and hoist it to a vertical position.

E. Connect torque-arrestor at the bottom of the discharge pipe, and adjust so that it fits snugly into the well casing.

F. Thread the first 20-ft section of discharge line into the pump.

G. Using a plastic clamp (i.e., tie-wrap), bundle the discharge line, electrical cable, safety cable, and sounding tube at 5- to 10-ft intervals.

H. Carefully lower the assembly into the well using the pump hoist.

I. After lowering the assembly to the first pipe coupling, place a holding device under the coupling and lower on to device. Add additional lengths of discharge pipe and sounding tube while repeating steps F-H until the pump intake reaches the next coupling, and repeat to the last section of pipe.

J. Place the sanitary seal on the final piece of discharge pipe (precut to the appropriate length), thread the final pipe onto the discharge line, and connect the safety cable to the seal.

K. A qualified individual will splice about 4 ft of 12-gauge, four-strand, sheathed electrical cord to the end of the 10-gauge electrical cable using solderless connectors. Feed the cord through the appropriate port and fitting on the sanitary seal.

L. Lower the completed assembly into the well and ensure that the sanitary seal top plate is horizontal with the top of the well casing. Evenly tighten the seal compression bolts to ensure that the seal provided by the rubber flange has no gaps and is watertight.

M. Connect the power cord in one of two ways:

1. In below-grade vault (i.e., Christy Box) applications, finish the cord with a 115- or 230-volt AC plug (male end) as specified by the FC. Also used for pumps of 1.5 HP and greater in above ground installations. Attachment C is a diagram of a below-grade wellhead completion.

2. In an above-ground “stove pipe” (protective casing) application, connect the power cord directly to the pump motor control box per manufacturer’s directions if 1 HP or less.

N. Place threaded plugs in the discharge line and sounding tube. Attachment D is a diagram of a well with a dedicated electric submersible pump.

6.5 Post Operation

6.5.1 Consult the SC or FC to develop a test to verify that the pump works and if it necessary to collect the pump test water.

6.5.2 Record the date of installation, the pump type, and actual pump intake depth in the dedicated well logbook and in the Pump Installation Logbook. The point-of-measurement (POM) for the pump intake depth should always be measured from the top of the concrete pad (0.3 ft. is allowed for pad thickness) and recorded as such.

6.5.3 Secure the protective casing with its lock.

6.5.4. Transfer a Xerox copy of all recorded information to the SC.

7.0 QA RECORDS

7.1 Well Logbooks

7.2 Pump Installation Logbook

8.0 ATTACHMENTS

Attachment A—Equipment Checklist

Attachment B—Well Completion and Pump Placement for Bladder Pumps

Attachment C—Below Grade Wellhead Completions

Attachment D—Wellhead Completion and Pump Placement for Electrical Submersible Pumps

Attachment A

Equipment Checklist

Equipment Checklist

_____ Appropriate wellhead sanitary seals matched to well diameter

_____ Bladder or electric submersible pumps

_____ Deep well wire water tight connectors (electrical sub.)

_____ Electrical cable (10- and 12-gauge, 4-wire), control boxes, and/or power plugs for electric submersible pumps, cable connectors (water tight)

_____ Fittings and valves for sampling tee's

_____ Schedule 80 polyvinyl chloride (PVC) pipe (1 to 2 in. depending on pump size) for discharge tubes on electric submersible pumps, sch. 80 pipe couplers (threaded)

_____ Schedule 120-40 PVC pipe (1 in.) to be used as sounding tubes for water level measurements

_____ Slip to slip well casing couples

_____ Slip to thread couplers for sounding tubes

_____ Stainless steel safety cable (1/8 in.) to span the distance from pump to top of the well casing

_____ Teflon lined or Teflon tubing for gas supply and discharge tubes for bladder pumps. Quick-connect fittings for tubing

_____ Threaded plugs for discharge and sounding pipes (electrical sub.)

_____ Tool kit

_____ Torque arrestor

Attachment B

Well Completion and Pump Placement for Bladder Pumps

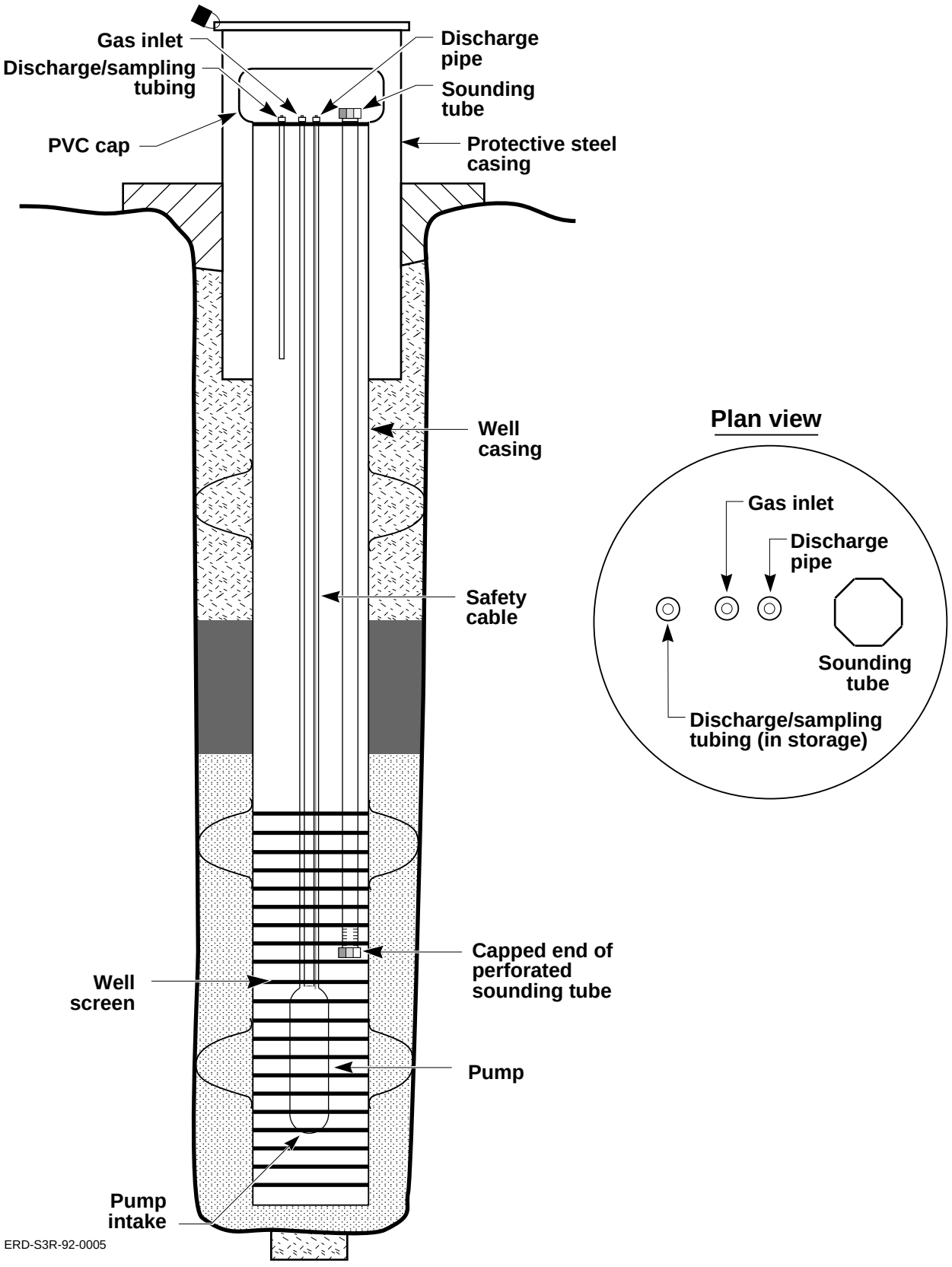
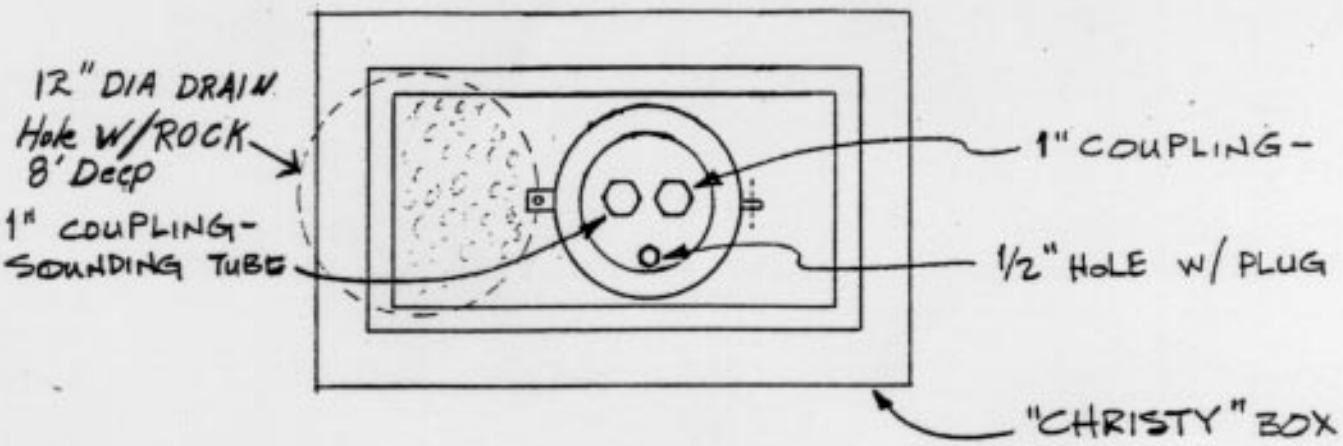
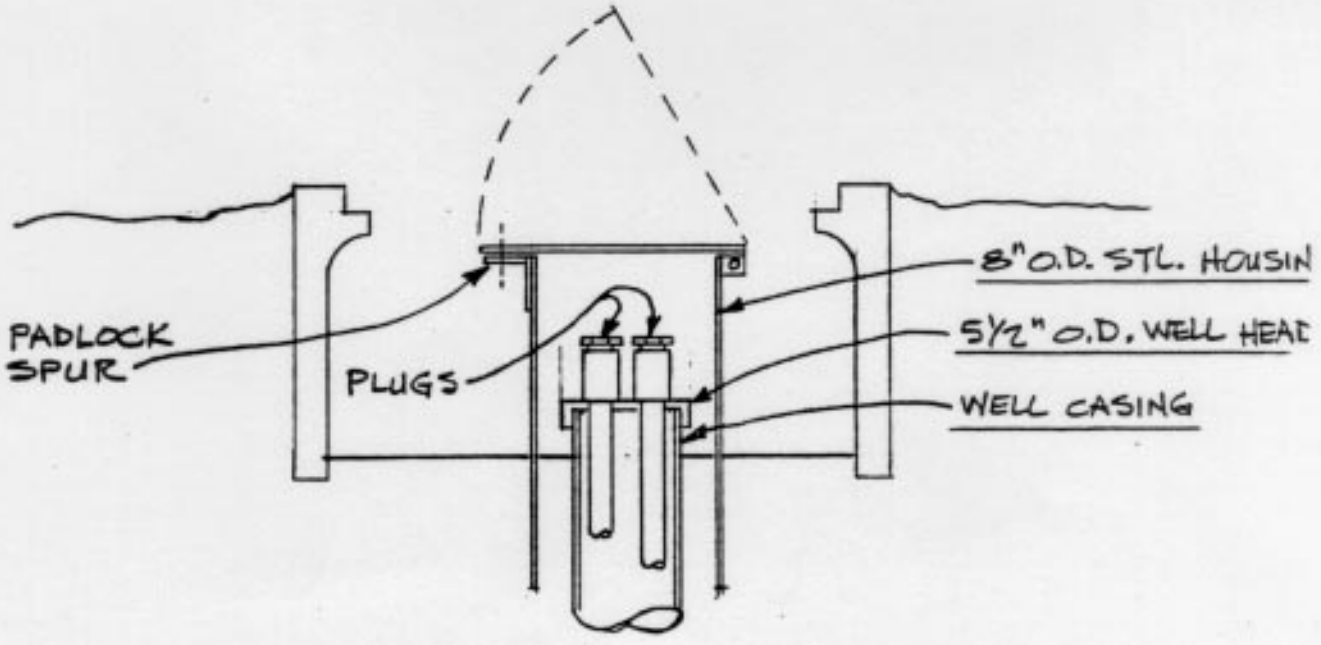


Figure 2.1-2. Wellhead Completion and Pump Placement for Bladder Pumps.

Attachment C

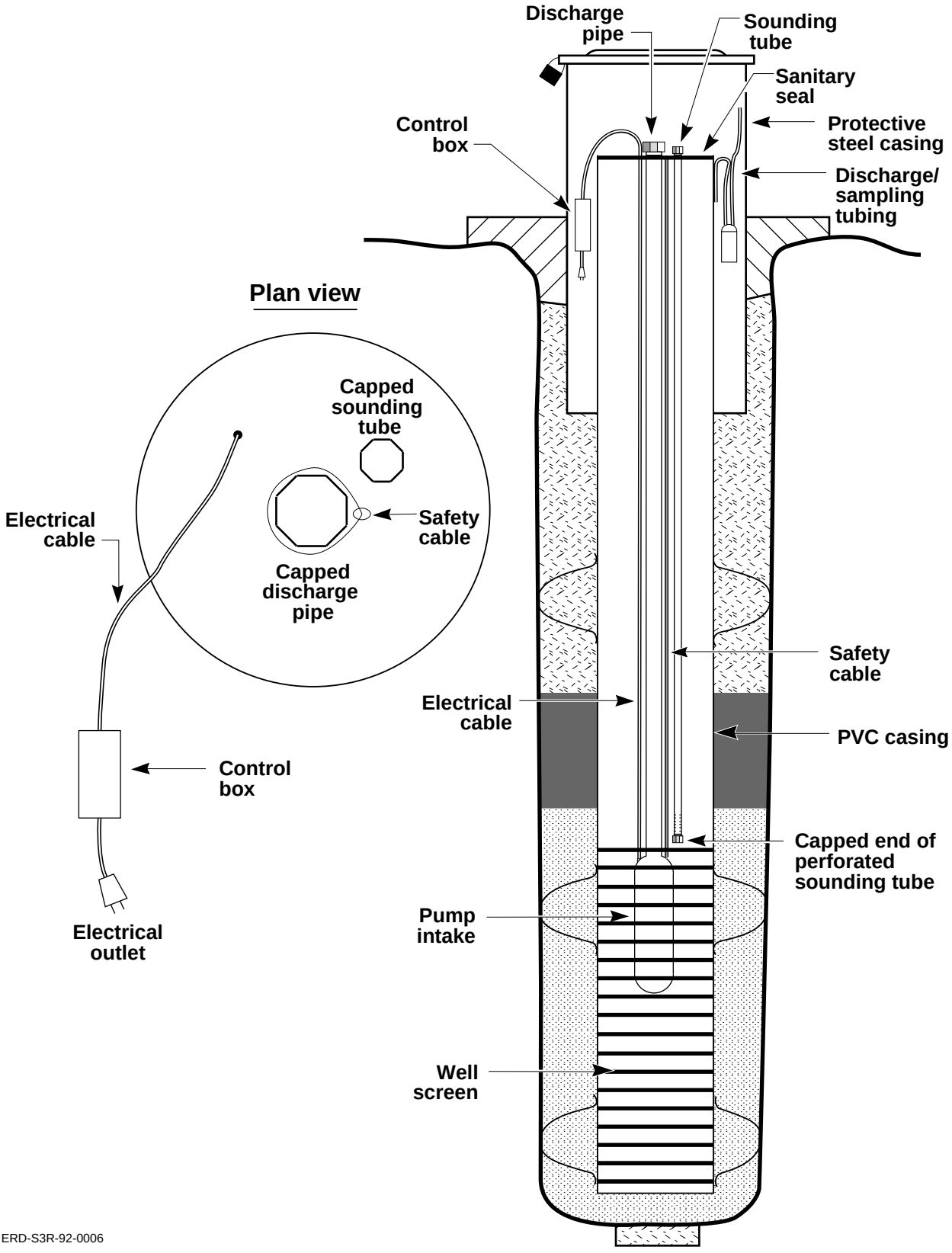
Below Grade Wellhead Completions


12" DIA DRAIN
Hole W/ROCK
8' Deep
1" COUPLING-
SOUNDING TUBE
1" COUPLING-
1/2" HOLE W/ PLUG
"CHRISTY" BOX


PADLOCK
SPUR
PLUGS
8" O.D. STL. HOUSIN
5 1/2" O.D. WELL HEAD
WELL CASING

Attachment D

Wellhead Completion and Pump Placement for Electrical Submersible Pumps



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